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Adaptive Toothbrush Handle: Case Report of a Thalidomide Patient

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Abstract - *Thalidomide poisoning can result in malformation of limbs, specifically upper limbs, compromising manual dexterity. Although Thalidomide has long since been withdrawn for use in pregnant patients, its affects on those exposed pose significant challenges for patients' oral hygiene maintenance. This case reports a novel technique of adaptation to facilitate a Thalidomide poisoned patient in maintenance of oral hygiene via an adaptive toothbrush handle.*

KEY WORDS: Adaptive toothbrush handle, Thalidomide, Case report

INTRODUCTION

Thalidomide was introduced to the pharmaceutical market in 1958, it was prescribed as an antiemetic and sedative medicament, with its popularity gained for reducing symptoms of morning sickness in early pregnancy. More than 40 countries licensed the drug worldwide[4] , under the trade name Distaval. The main advantages were that it purported to lack the addictive property associated with traditional barbiturates and it produced a calm, natural sleep. Initially, the only perceived side effect was that it induced prolonged sleep if used excessively.

However, in December 1961 two reports of possible harmful effects on developing fetuses in early pregnancy were published[1,5]. Consequently, exposure to Distaval, whilst in utero, was shown to lead to a variety of adverse effects, which included sensory impairment, Phocomelia, (a rare congenital disorder involving underdevelopment of the limbs) and death. Up to 10,000 individuals worldwide were affected**.** Commonly, hands and limbs were either truncated leading to 'flipper-like' hands and/or feet, or they were simply absent (Table 1). Although animal trials were conducted prior to its use in humans, testing was restricted to non-pregnant rat subjects; the results therefore indicted falsely that Distival was safe and fit for purpose[7]. The rationale for selecting the type of animal model was attributable to the scientific community of the day, firmly believing the placenta to be 'impervious' to drug transfer, unless the mother died from ingestion of the drug[2]. In December 1961 Thalidomide was withdrawn from the UK market due to possible "harmful effects on the foetus in early pregnancy".

It is axiomatic that shortening of the arms and the deformity of the hands and fingers caused by Thalidomide poisoning can lead to significant problems in maintaining good oral hygiene. Adaptations to toothbrushes have shown to produce a significant clinical improvement of oral hygiene in disabled patients . This article details the case of a patient affected by Thalidomide poisoning and the construction of an adaptive toothbrush handle in order to help him maintain a good level of oral hygiene.

CASE REPORT

Mr B. a 46-year-old IT employee was referred to the Restorative Department of The University Dental Hospital of Manchester (by his General Medical Practitioner) for the replacement of a failing long-span bridge. The patient's presenting complaint was of 'a loose bridge', which was constructed approximately twenty years earlier. Medically, Mr B. was diagnosed with Phocomelia of the upper limbs, mild hearing loss in the right ear and infrequent panic attacks. His restorative treatment comprised standard prophylaxis therapy, multiple fixed restorations and an upper Cobalt Chrome denture.

On examination, it was apparent that Mr B's ability to maintain a high degree of oral hygiene was significantly compromised; subsequent to questioning and observation of his tooth brushing technique, this was attributed to MR B's shortened arms, absence of a thumb and malformed fingers (figure 1). An electric toothbrush was supplied to the patient; this however proved deficient in terms of length and manoeuvrability. Plaque and bleeding scores indicated that both palatal and lingual surfaces (particularly the upper and lower right quadrants) were most challenging for the patient (bleeding 62% plaque 49%) (figure 2). After discussions with Mr. B and dental technologist, a decision was made to design and fabricate a customised toothbrush handle.

METHOD OF CONSTRUCTION

It was noted that Mr. B relied predominantly on his right hand and that his left hand was significantly weaker. It was therefore decided that the custom-made handle needed to be rotatable and flexible enough to allow his electric toothbrush to be rotated through an angle in excess of 180

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Table 1. *Features of Thalidomide poisoning*

• Absence of auricles (outer portion of the ear) +/- deafness
• Defects of muscles of the face and eye
• Absence or hypoplasia of arms, usually affecting the radius and thumb
• Thumbs with three joints
• Defects of the tibia and femur
• Malformations of the heart, the uterus, the bowel, and the gallbladder

Figure 1. *Dexterity before usage of adaptive device (difficulty manipulating toothbrush for lingual area).*

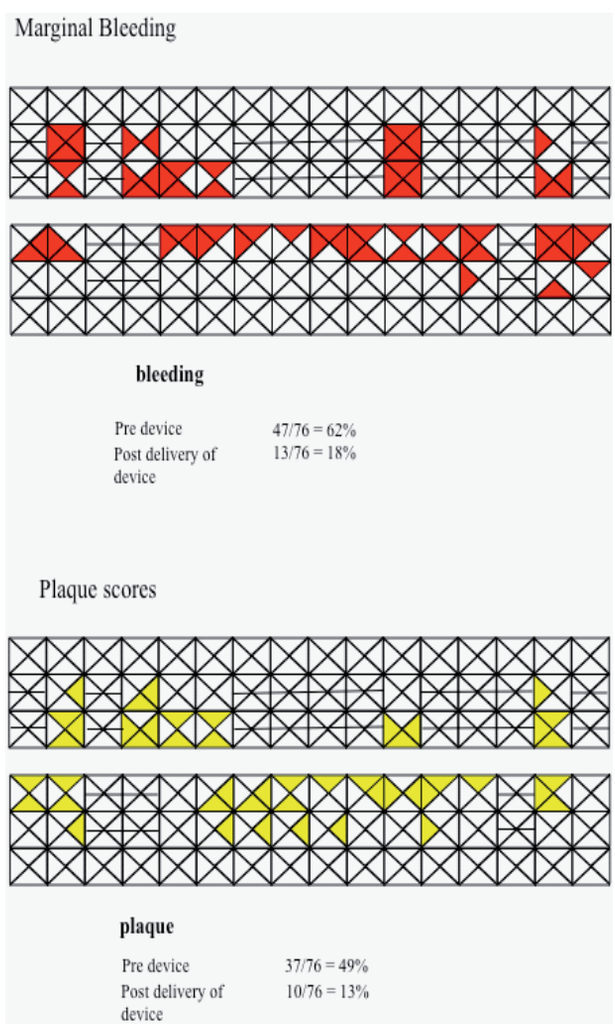

Figure 2. *Plaque and bleeding scores before and after adaptive device usage.*

degrees. The principle component of the device consists of a flexible arm taken from a commercially produced mobile phone holder.

Stage one in the process of modifying the rotatable arm involved removing the portion that connected to the phone holder and customising it to accept the electric toothbrush (figure 3). This was achieved by making an impression of the base of the patient's toothbrush in addition-cured silicone material. From this, a stone replica was made, on which the toothbrush holder was thermoformed from a 2mm clear blank of polyvinyl acetate material.

Stage two of the procedure required the opposite end (i.e. the plug socket portion of the arm) to be adapted by removing all of its electrical components in order to form a rudimentary handle. This component underwent further customisation to form a more ergonomically acceptable grip via the use of a biodegradable thermoplastic material (figure 3).

On delivery the handle was further adapted to include a lip at its base in order to improve balance and stability. This simple procedure was performed at the chair-side by re-softening the material in hot water at a temperature of circa 60^{0}C. With digital manipulation, the plastic was contoured to fit around the patient's hand and left to cool at room temperature for 3 - 4 minutes. (figure 4).

On the subsequent appointment it was found that the patient's oral hygiene had improved considerably due to his enhanced manual dexterity through the use of the adaptive toothbrush handle (figure 5). As a result, Mr. B's plaque and bleeding scores had decreased appreciably (bleeding 44%, plaque 36%). During a periodic review appointment, the patient was offered additional modifications to the holder to make it more ergonomic. However, Mr. B declined the offer of further modifications and stated that he was very happy with the current configuration.

DISCUSSION

Techniques for adapting toothbrushes have been discussed previously. Automated devices provide a high level of customization for patients' needs; however their expense

Figure 3. *Adaptive tooth brush device: thermoplastic hand grip, semi-rigid plastic arm and fitting device for rotation.*

Figure 4. *Polymorph (biodegradable thermoplastic material).*

Figure 5. *Adaptive tooth brush device with lip modification.*

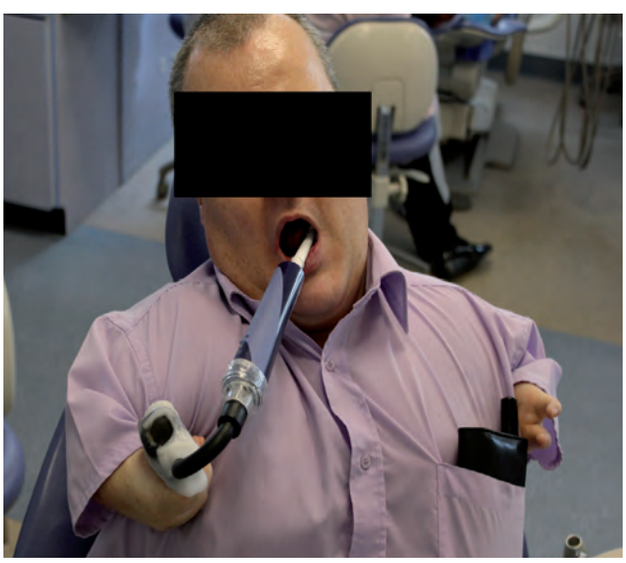

Figure 6. *Dexterity with usage of adaptive device.*

and cumbersome nature make them of little use to the disabled population. Silicone adaptations are simple to use and cheap[12], but do not allow for re-adaptation. The principle advantages of Polymorph thermoplastic material stems from its re-adaptability and cost effectiveness. Furthermore, its biodegradability and non-toxicity makes it an ideal material for chair-side and domiciliary care settings. Its ability to be re-shaped can be utilized for patients, in which changes in mobility and/or grip strength (e.g. arthritic patients) are common, as the handle can simply be adjusted to cater, without necessarily the need to remake the device.

Currently, thermoplastic materials of this type are used in drug delivery devices, sutures, forensic medicine and as a root canal material in dentistry.

Patients who have been exposed to Distaval, enter the restorative cycle of placement and replacement of restorations , owing to the deleterious effects of poor oral hygiene attributed to the malformation of their upper limbs and the consequential difficulty in oral hygiene maintenance[12,13]. Oral health can impact on psychological health of disabled patients; as maintaining one's own oral hygiene imparts the idea of independence and well being[14], consequently well being can be experienced through self care.

The technique described in this case report involved adaptation and ingenuity for the requirements of the patient to foster good oral hygiene. An improvement in Mr B's oral hygiene supports the notion of success for the device. (figure 4). For patients with a disability, an adaptive application of preventative measures (e.g. toothbrush adaptations) helps to ensure they can achieve and maintain good oral hygiene. Polymorph, a pliable material, was used to facilitate the desired result.

Adaptive prevention can play a critical role in improving the disabled patient's oral and psychological health.

CONCLUSION

This case reports a novel technique for successfully adapting a toothbrush handle to facilitate a Thalidomide poisoned patient in maintenance of oral hygiene.

MANUFACTURER'S DETAILS

- Mobile phone holder - Kensington Computer Products Group™, Aylesbury UK
- Addition-cured silicone material - Labosil Pro 90™, Dreve, Germany
- Polyvinyl acetate material - Eurkodent® Erich Kopp GmbH
- Biodegradable thermoplastic material - Polymorph® Thermoplastic Material University Teaching Recourses, Waltham Cross, Hearts UK

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